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ABSTRACT

Intended for immediate use by researchers and practitioners exploring or developing networks for innovation and problem solving, this paper synthesizes the findings and ideas gained from writing 15 case histories of networks and major subnetworks, and interviewing leading participants in 12 additional networks; most of the networks are devoted to improving education. The paper begins with a discussion of the ingredients essential to networks for innovation and problem solving, presents in the second section other network characteristics and their variations, and concludes by portraying a pattern of change which appears common, but not inevitable, among networks. Appendices provide (1) a case history of the Federation for Unified Science Education, (2) a description of three computerized networks, (3) a bibliography of related literature, (4) a list of the network case histories written, and (5) a list of the networking practitioners interviewed. (Author/JD)

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NETWORKS FOR INNOVATION AND PROBLEM SOLVING

AND THEIR USE FOR IMPROVING EDUCATION: A COMPARATIVE OVERVIEW

by

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NETWORKS FOR INNOVATION AND PROBLEM SOLVING

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INTRODUCTION

For two decades the educational community in the United States has been experimenting with various strategies to improve education. After the shock of Sputnik, many curriculum development projects and subsidized teacher training programs were tried to upgrade the content of schooling. National action programs like Head Start also were initiated to better the lot of specific groups. Regional Educational Laboratories, R&D Centers, and ERIC Clearinghouses were established to strengthen research, development and dissemination. Federal and state governments tried everything from fiat to subsidizing local initiative. Although these strategies have had some impact, they have not accomplished the widespread renewal sought by policy makers and the educational community.

Another, complementary approach to educational improvement might make the difference. It is the network strategy for innovation and problem solving. "Networking" has long been used by some innovators and problem solvers within the education sector as well as in other fields. Only recently, however, have educational policy makers begun to consider how networking might be deliberately used to accelerate desired changes in schooling. What is networking? How do networks for innovation and problem solving come into being and develop? What are their strengths and weaknesses as means for improving education? What roles can funding agencies play in the strategy?

Seeking answers to these questions, the Network Development Staff of the National Institute of Education (NIE) commissioned me to write case histories describing thirteen networks and major subnetworks. The

The cases are enumerated in Appendix D along with two cases which Priscilla Claman and I composed for the Center on Technology and Society (CTS). The NIE Staff also asked me to interview leading participants in a dozen additional networks in order to gain a broader perspective. Appendix E lists these practitioners and other people who shared their networking experiences with me and/or several other CTS associates. The findings and ideas gained from these interviews and case descriptions are synthesized in this comparative overview. Although some of its details are tentative, the synthesis as a whole is intended for immediate use by researchers and practitioners exploring or developing networks for innovation and problem solving.

The paper begins with a discussion of the ingredients essential to networks for innovation and problem solving. Other characteristics and their variations among networks are presented in the second section. The concluding section portrays a pattern of change which appears common, but not inevitable, among networks. Having examined networks outside the education sector as well as within, the findings and ideas are stated as assertions regarding all kinds of networks for innovation and problem solving. However, the examples in this paper usually come from networks devoted to improving education; a history of one of these networks is included in Appendix A. Since some computerized information sharing networks are similar to networks for innovation and problem solving, three computerized networks in education also are mentioned in Appendix B, with emphasis on traits instructive for non-computerized networks.

Among the 28 networks studied for this paper, exceptions were found to nearly all general statements about networks. There appears to

be no "best" way to build and run networks in general. It is, rather, a contingency management problem with multiple options depending upon the goals and circumstances of the people involved in each networking effort.

To develop a systematic model of networks synthesizing the realities of practice with the theories in the literature (see Appendix C) will require a major undertaking. Additional in-depth case histories are needed as well as comprehensive comparative studies which give more examples than the illustrative points made here. The ideas and findings in this paper can be used as hypotheses for these studies. Thus, in a spirit of mutual sharing, this comparative overview is contributed to the "network" of networking theorists and practitioners.

I am grateful to everyone interviewed by CTS for their generosity with time and materials. In particular, I thank Charles Thompson from the NIE Network Development Staff for the insights he provided during many talks we have had, and for his critiques of several of my draft documents.

Special credit goes to Priscilla Claman for her contributions to the fundamental concepts in this paper as well as to its examples. In many illuminating discussions, she clarified various patterns and added ideas which she had conceived during her own explorations of networking. She should be considered a collaborator in authoring portions of the paper.

L. Allen Parker
October 1977

SECTION I

Key Ingredients of Networks for Innovation and Problem Solving

A social network consists of net-like linkages among people. Social networks have more structure than disorganized groups, while still exhibiting a net-like flexibility. Networks also are open-ended; people can be added to or subtracted from a network with such ease that its exact boundaries frequently are impossible to determine. At the same time, social networks usually have both central and peripheral participants. New patterns of linkages among the participants can be formed with ease, and the linkages vary in strength. Some of these networks are so fluid that their linkage patterns cannot be mapped without becoming dated during the process.

Since a diversity of networks exist, Kadushin (1977) and Schon (1977) have formulated categorization schemes for the different types. Among the types are the kinship networks studied in anthropology (Barnes, 1972), the "natural helping networks" researched by social workers (Collins and Pancoast, 1976), and the diffusion networks mapped by geographers (Berry, 1977; and Hagerstrand, 1967). The role of person to person networks in the dissemination of industrial technology has been examined by Allen (1977), while Craven and Wellman (1973) view the city as a network of networks. Trade and professional associations also can be considered networks, as can the "invisible colleges" of active researchers in any field (Crane, 1972; and Griffith & Mullins, 1972). Finally, informal establishment cliques or "old boy" networks play a major role in controlling the activities within and among all kinds of formal organizations and well-established systems.

When people want to solve problems or do new things, they often turn for assistance to well-established systems and organizations. For example, the teacher wishing to obtain a new text discusses the purchase with appropriate school system officials, submits a request through standard paperwork channels, and receives the book by way of a predictable transportation system. In some cases, however, the established channels prove inadequate or even obstacles to solving problems and doing new things. This is especially true when the problem has never been solved before in the particular location, or when the new undertaking is highly innovative. Under such circumstances, the potential innovator or problem solver either gives up or creates new channels to link with people who can provide the information and assistance needed.

Innovators and problem solvers who link-with other people in their field during their searches for assistance can form a network-like configuration of people devoted to solving similar problems or introducing similar innovations. Some people will have contact with only one or two others in the network and might not be aware of the broader configuration. In some other cases, individuals seeking information and psychological support in their problem-solving or innovative efforts will be referred from person to person through a chain of people before finding the sought-after help. At least one person in the chain is likely to be the source of referrals, information and psychological support for many innovators and problem solvers. These resource persons are likely to be well aware of the network-like collectivity. Furthermore, the resource persons can deliberately stimulate interaction among participants in the network as a means of increasing the participants' effectiveness in sharing information and psychological support.

Deliberately-stimulated interactions among innovators and problem solvers in some networks remain informal and minimally organized, while in other networks the participants develop names for the networks and some formal operating procedures. Regardless of degree of formality and structure, however, these networks of innovators and problem solvers can be distinguished as a group from the other kinds of networks already mentioned, as well as from established systems. This distinct group is called "networks for innovation and problem solving" in this paper. The approach used by the innovators and problem solvers to assist each other is "networking."

Note that in this paper, "problem solver" refers to an individual in the process of solving a problem in his or her organization or field, while an "innovator" is someone introducing a new program, product or practice. Innovators can invent the new process or product, or they can imitate or adapt the inventions of other innovators. Since some individuals invent, adapt or imitate innovations to solve problems, they can be considered problem solvers as well as innovators. As elaborated in Section II, the networks examined by CTS contained both creative local problem solvers and people imitating innovations developed elsewhere in their networks.

During our interviews, we at CTS often were told that networks had to have certain traits in order to be effective in assisting innovators and problem solvers. Many of these traits varied according to the nature of the interviewees' networks. On closer examination, the traits which varied among networks appeared to be different points along the seven dimensions elaborated in Section II. The remaining traits were common to

all networks for innovation and problem solving. These ingredients, which are described in this Section, included the following:

- a sense of being an alternative to established systems
- a feeling of shared purpose
- a mixture of information sharing and psychological support
- a person functioning as an effective facilitator
- an emphasis on voluntary participation and equal treatment.

An Alternative to Established Systems

Since networks for innovation and problem solving are joined because people are seeking assistance outside of established systems, participants in the networks usually feel that the networks are alternatives to the systems. Many participants consequently have a sense of being part of a special group or movement. Also, they often feel somewhat isolated from the established systems in their fields of concern.

The networks are treated in different ways by members of the established systems. Most members of the systems ignore or are unaware of the networks created as alternatives to their systems. In a few cases, however, leaders of established systems actively support selected networks as a means to solve intractable problems. The opposite is true of some other systems, whose leaders view networks as undesirable or threatening, forcing the networks into an adversary or underground mode of operation.

Boston West Biology Teachers (BWBT) provides an example of a network which has functioned without sanctions from the school districts where its participants work. In the middle 1960s, high school biology teachers in metropolitan Boston wishing to experiment with new curricula

could find few if any similarly-concerned teachers within their school districts. Furthermore, the regional and national associations established for biology teachers met infrequently at places which usually required substantial time and expense to reach. Five teachers from three suburban districts near Boston began meeting in the Fall of 1967 because they were seeking a way to share information and psychological support for their innovative efforts and day-to-day problem solving. The five in turn invited other teachers to join their sharing activities, which have been coordinated by Lawrence Nilson, Sue Plati and Harold Wiper throughout most of the network's history. BWBT currently links about 150 teachers from fifty districts, eleven parochial schools and five private schools, as well as concerned individuals from three colleges and two resource organizations. Few of the school districts' administrators are aware that the group exists or that it uses the facilities of a different district each month for its monthly meeting. Neither do most of the administrators know, nor probably would they care, that the teachers quietly use resources of their schools to mimeograph many extra copies of their best curriculum units when they wish to distribute them to other BWBT participants.

By contrast, the activities of the Allied Medical Education network are actively supported by the governing councils of the American Medical Association. The AMA has backed the gradual expansion of the facilitating staff from three to eighteen people because the network has proved to be an effective information sharing and conflict resolution mechanism among the numerous specialist societies in the established health care system. Each of these physician and technician societies protects its "turf" and its independence, resisting any coordination attempts by the AMA or

government agencies. However, improved patient care frequently requires cooperation among the societies in determining how their members should be educated since they often must work together i delivering services. To foster cooperation among the independent societies in determining guidelines for accreditation, an AMA staff member, Ralph Kuhli, began applying networking techniques. Before long it was evident that the network he was building could achieve voluntary conflict resolution where the established system had failed. Physicians, other allied health personnel, and educators began praising the network to the AMA governing councils, which in turn allocated more resources for Kuhli to expand his staff and activities.

Two other instances of establishment support for networks are the cases of the National Diffusion Network (NDN) and the /I/D/E/A/ Change Program for Individually Guided Education (IGE). The U.S. Office of Education (USOE) has allocated $25 million to the NDN program since 1974, while Charles F. Kettering Foundation and other sources have provided almost $10 million for the Change Program since 1968. Headed by two USOE officials, Jean Narayanan and Lee Wickline, the former program has developed a national network for facilitating the dissemination and adoption of 65 "exemplary" innovations developed by local schools in a diversity of fields. Similarly, the /I/D/E/A/ Program, led by John Bahner, has encouraged the formation of many regional "leagues" of schools in the process of implementing a comprehensive approach to individualized learning and continuous teacher improvement. In both cases, the funding agencies were convinced that the exemplary programs and practices would not spread widely through established channels in the American educational system, but instead

required the special information sharing and psychological support most likely to be provided by networking.

Although networks are alternatives to es cablished systems, they can become rather formal, as in the Allied Medical case. (This point is elaborated in the Section II discussion of "Informal and Formal Structures.") Only when a network becomes the generally-accepted source of assistance in a field will it stop being a "network for innovation and problem solving," becoming instead an establishment organization, such as a professional association or a government-supported service center. The network which becomes an established system, in turn, is likely to spawn new networks of people seeking alternative means for assistance in their innovation and problem solving. Thus, a cycle of network change sometimes begins again, as discussed in Section III.

None of the networks we examined were so threatening to established systems as to require their taking an adversary or underground stance. Although many of these networks do have an explicit objective of gaining more resources from established systems, they have not been involved in confrontations, nor have they felt pressures to go underground. The explanation for this finding might be in the suburban nature of almost all of the networks. Networks like the IGE movement,the National Diffusion Network, and the Boston West Biology Teachers which have tried to involve urban public educators have had little success in attracting them. On the other hand, the now-defunct Ford Foundation Comprehensive School Improvement Program, which (at high cost) did include big city public schools, reported the emergence of important political constraints. The resources in most big cities are sufficiently meager and the populations

sufficiently heterogeneous in educational philosophy that major resistance to change efforts might be inevitable. In fact, networks for innovation and problem solving simply might induce the creation of counter networks in a manner similar to anti-busing groups forming in response to pro-busing groups. Based on the findings of urban education experts at the Boston University Institute for Responsive Education, it could be conjectured that power issues, and possibly confrontation, would be important to any network focused on innovation and problem solving in big city public schools. Furthermore, as Peterson (1977) maintains, immediate material incentives might be needed to sustain networking in inner cities, unlike in middle class communities where a sense of shared purpose and the affiliative benefits of participation are adequate incentives.

(It is noteworthy that social work researchers have found many "natural helping networks" among welfare recipients and other people in poor communities [see Collins and Pancoast, 1976]. These networks form around indigenous facilitators who assist others in bypassing the established system and in coping with day-to-day survival problems. Since natural helping networks assist their participants with day-to-day problem solving, the networks are similar to some networks for innovation and problem solving, e.g., Boston West Biology Teachers. However, the helping networks appear to involve much less innovation than BWBT and the other networks studied by CTS. The picture is complicated further by the fact that poor urban parochial school educators are active participants in BWBT and the IGE movement. Additional research is needed on the existence and functioning of inner city networks for innovation and problem solving.)

Sense of Shared Purpose

When people seek assistance to innovate and solve problems in a given field, they naturally look for other people who are devoted to the same purpose. The purpose may be highly defined, as in the case of the Laser/Electro-Optics Education network, which assists schools, hospitals, business firms and government agencies in establishing programs for training people in the safe use and maintenance of lasers. At the opposite extreme, the purpose may be as broad as the Allied Medical goal of providing better patient care, or the Northern Westchester Resource Network concern "to help individuals and groups find external and internal resources for lifelong development in self-selected ways productive for themselves and their environments" (see page 3 of the Northern Westchester Resource network case listed in Appendix D). The key factor for a network is that its purpose elicits commitment and a sense of community.

It appears that a major challenge facing many network organizers is to define a purpose which is neither too specific nor too general to achieve the sought-after commitment. In some cases, an overarching unity can be found which permits a pooling of diverse objectives. This has been obtained by the National Diffusion Network where the Developer-Demonstrators of the 65 innovations have teamed to help build the network, even while vying with each other to gain preferential treatment from the State Facilitators who link schools in their states with Developer-Demonstrators throughout the nation. Some other networks might require a narrowing of focus and a loss of potential participants in order to achieve the necessary member commitment. For example, the New England Appropriate Technology Network with its general focus on promoting small-scale technology has

been unable to bridge the gap between two major factions: those who wish to develop and disseminate "small-scale" means of living and producing, and others who seek to mobilize a New England mov ent to limit the continuing growth of large-scale technology. When a network has a purpose which elicits commitment, its participants can focus their attention on the interrelated functions of information sharing and psychological support.

Information Sharing and Psychological Support

Participants in a network share information relevant to their common purpose. Telephone and face-to-face interactions among the participants and between them and an individual or group acting as a facilitator usually are the main vehicles for information sharing in new or small networks. As a network expands, other mechanisms also can become important (as elaborated in Section III). Examples of these mechanisms include: newsletters and journals; directories of participants; catalogs describing participants' activities; case studies of problem-solving efforts; and guidebooks and training materials for innovations. Although these mechanisms are similar to those used by established systems, they are more likely to be focused on the specific needs of network participants, who otherwise would not have become involved in the network. A network which stops meeting participant needs usually disintegrates or becomes latent--unlike many established systems which have institutionalized sources of support and can afford (in the short run) to ignore the needs of clients. For the same reason, the telephone and face-to-face interactions in a network are likely to provide more relevant information than can be obtained from most established systems.

Telephone and face-to-face interactions offer the vital additional benefit of psychological support. Unlike "information sharing," which is a commonly used term this second benefit of networks lacks a clear definition and universally-accepted name. Terms like "family feeling," "moral support," "excitement," "spirit," "inspiration" and "magic" are some of the words used by participants. Whatever the term used, it refers to a strong, positive emotion experienced by active participants in networks. (The lack of agreement on a name for the emotion might indicate that different participants are experiencing different positive feelings derived from the satisfaction of various motives and needs such as the mixture of "altruistic" and "selfish" motives discussed in Section II.) These emotions compensate for the sense of isolation, frustration or boredom many network participants feel in the established organizations where they are based. Furthermore, the positive emotions influence participants to behave in an altruistic, trusting manner when interacting with other network members. The result is more effective information sharing as well as more positive feelings.

Many networking practitioners would argue that these feelings are not the "second" benefit, but the first. Thus, according to one interviewee, "information sharing is only the excuse for the face-to-face interactions producing good vibes." Networks can vary their mix of the two benefits, but total neglect of either makes their effectiveness as "networks for innovation and problem solving" questionable. The network which offers only information might be considered some kind of communications system, while the network limited to psychological support is some kind of social club or therapy group.

Although most network facilitators are aware that their networks provide both information and psychological support, only a few networks have built both functions into their explicit purposes. The Organization Development or OD Network is one of these. The OD Network was founded by a dozen industrial personnel managers who had been experimenting with sensitivity training programs as a means to improve employee relations and group dynamics in their corporations. Since the programs had had little impact, the managers also had begun to develop new approaches to changing their organizations which later gained the generic title "Organization Development." These managers were receiving little or no encouragement from other executives in their firms, and minimal support from their fellow sensitivity trainers in the National Training Laboratories (NTL) network; the executives simply were not interested, while the latter group lacked relevant experience, being based mainly in universities. The solution for the managers was to create the "Industrial Network" (later called the "OD Network") in 1964 with a two-fold purpose. As stated by Warner Burke, the facilitator who built the network during eight years of its development, the purpose was "one, to keep up with the state of the art; two, to have our social and affiliation needs met, nourished and so on" (OD Practitioner, 1973: 1). In our recent interview with Burke, he repeated this purpose, putting the second half first and rephrasing it as "to come together and hold hands."

A major operational challenge facing all network facilitators is the arrangement of opportunities for face-to-face interaction and "hand holding." Ideally, according to many facilitators, the interaction would happen as often as once a month. Due to practical constraints on many

national networks, however, face-to-face interaction can be arranged only once or twice a year. These networks attempt to compensate for infrequent meetings by developing regional subnetworks (as explained in Section II), and by carefully planning the content and processes of meetings. In the case of the NTL network, for instance, the two week annual workshops in Bethel, Maine, were so successful that they came to be viewed as a kind of Mecca for sensitivity trainers. A very strong sense of magic and family feeling sustained NTL participants throughout the rest of the year.

Among the terms referring to psychological support, "family feeling" is especially significant because it explains the altruism and trust evident among most active participants in networks for innovation and problem solving. Due to the feeling of trust, many participants openly discuss their problem-solving failures even when their listeners can exploit the information. Moreover, participants in effective networks share their innovative ideas and materials because they assume that they will not be "ripped off" by other participants. There is a strong sense of loyalty to the family of network participants. Network facilitators, in particular, are likely to exhibit loyalty as well as altruism, which makes them logical recipients of the participants' sensitive and valuable information.

The facilitators of the Boston West Biology Teachers and the Federation for Unified Science Education (FUSE) are cases in point. (FUSE is described at length in Appendix A.) They each have files full of uncopyrighted materials developed by their participants and donated to the respective networks for sharing with other participants. Over time,

the BWBT and FUSE collections have become substantial and the facilitators have gained much knowledge about the best ways to use the materials. Since curriculum development centers and commercial houses find this knowledge valuable they have approached the facilitators seeking to tap their expertise and files. The facilitators have refused to cooperate, or have cooperated in ways which protected the contributors and the trusting environment of their networks.

Many networking practitioners think that network participants should make voluntary contributions to information sharing and network operations for the sake of the group or the cause. Although most active participants feel that they eventually must get something from the network in order to remain active, they generally do not calculate how to get an immediate return for each input. Some networking practitioners view this attitude as "altruistic," while others consider it to be "selfish." This distinction is partially a problem of semantics, which might be resolved by the concept of "reciprocal altruism" described in Section II. Regardless of semantics, however, people who are always calculating tend towards the periphery of networks because they and the central participants often find interaction unsatisfying. If the central participants in a network stop being altruistic at least part of the time, the network's effectiveness in providing information and psychological support is substantially reduced, and the network sometimes disintegrates.

Effective sharing of information and psychological support sometimes results in cooperative projects. Since participants in a network have similar goals, the open sharing of information is likely to lead to an awareness of situations in which teaming could result in benefits for

everyone involved. Networks like the National Diffusion Network and the Northern Westchester Resource Network even make the development of joint projects a major objective. The NDN links the developers of innovations in a field like reading with local schools seeking the same kind of innovation, and anticipates that agreements will result for the developers to assist the schools in exchange for consulting fees and/or the satisfaction of seeing the innovations adapted or adopted. As in the IGE movement, the NDN encourages participants to make formal contracts with each other in order to avoid misunderstandings regarding the time and resources they are committing. Similarly, the Westchester Network, founded and co-coordinated by Elizabeth Meyer Lorentz, promotes the matching of complementary needs and resources among a diversity of educational institutions and other organizations in the community. The resulting projects, in fields such as environmental education and child care, also involve private citizens. (See Sarason et al. [1977] for a lengthy discussion of resource exchange in networks.) Cooperative projects are desirable outcomes found in all networks, but do not appear to be essential network ingredients. The sharing of information and psychological support is sufficient motivation for participants to establish and maintain networks for innovation and problem solving.

A Facilitator or Coordinator

All these networks have one or more participants who consciously facilitate the sharing of information and psychological support. By far the most common titles for these individuals are "facilitator" and "coordinator." Some networking practitioners prefer the former word because they think the latter implies too much directiveness. On the other hand,

some practitioners think "facilitator" is too vague and point out that the role being named frequently includes a good deal of coordinating activity. Both groups of practitioners agree that the role involves little up-front directing of network activities, except in institutionalized networks of the sort described at the end of Section III.

In many of the networks we examined, the leading facilitators or coordinators also were the founders of the networks. When innovators and problem solvers linked together in a new area of concern, certain participants became major sources of referrals, information and psychological support, as already indicated. One, or sometimes two or three, of these source persons was likely to make the decisions to begin deliberately stimulating interaction among the participants in the network. This sometimes was done by calling a meeting, as in the BWBT case, or by starting a newsletter like that of Resources for Alternative America. If other participants responded positively, the source person generally became the facilitator or coordinator. Founding participants in some other networks (e.g., FUSE) asked one or more source persons to perform the facilitating role. Yet another pattern, evident in some networks with substantial financial backing (the National Diffusion and OD Networks), is for leading network participants to recruit facilitators from outside the initial group. A variation on this approach has been taken by funding agencies which select facilitators to found networks in areas which the agencies judge to be ripe for networking, e.g., the Teachers' Centers Exchange for the teachers' centers movement.

Both effective and ineffective facilitators have been selected in each of the above ways. Moreover, it appears that individuals with non-

abrasive personalities can learn on-the-job to be effective facilitators. There also are cases, discussed in Section III, which indicate that older networks can select and train successors to their founding facilitators. The method of selection and training does not seem to be so important as the facilitator's sensitivity to other people and his or her determination to create and maintain the key ingredients of networks for innovation and problem solving. Because examples of dedicated facilitators and their role are given throughout this paper, none are provided here. Instead we turn to the final key ingredient.

Voluntary Participation and Egalitarian Treatment

Most participants in the networks which we at CTS have examined have come from different locations or organizations. When different individuals from the same organization at the same location interact regularly to bypass the established system in their organization, we consider them to constitute an informal organization or faction, rather than a network of the kind we are studying. (However, further research might demonstrate that informal groups for innovation and problem solving within an organization have traits analogous to the networks examined here.) Having been created as alternatives to established systems, networks usually cannot offer potential participants the attraction of establishment legitimacy. Network participation might even reduce the participant's credibility with other members of the established organization where he or she is based if the network is viewed as questionable or subversive--unlike membership in a powerful professional association which must be joined for career advancement. Consequently, network participation usually is a totally voluntary act. Voluntary participants, in turn, can

insist that a network respect their independence and treat them as equals in exchange for their continuing participation. As a result, one of the appeals of networks for many participants is the equal treatment accorded people from positions of disparate status, such as nationally-known professors and local elementary teachers.

Despite the emphasis on equal treatment, there are variations in the amount of influence different participants have in any network. In particular, the network facilitators are likely to have disproportionate influence due to their superior knowledge of the network as a whole and to the special facilitating skills they develop. Some networks can even be considered hierarchic. For example, the Wisconsin R&D Center establishes state and local IGE networks with a total of five overlapping "levels." However, leading participants in the IGE networks treat other participants in an egalitarian manner by being responsive to their statements and by including representatives of the "lowest" level, i.e., teachers and pupils, in the "highest" level councils. In these networks and others, facilitators and leading participants often avoid titles like "chairperson" or "director," opting instead for "secretary" or "coordinator" in order to maintain lower profiles. Thanks to their altruistic politics and emphasis on family feeling, these facilitators can induce continued sharing among network participants whose concern for autonomy would otherwise minimize their involvement.

If network leaders or facilitators start using their positions in a manner which threatens the equal treatment of network participants, the future of the network is endangered. This happened, for instance, in the case of the PROJECT OPEN Presidents' Network, which was designed to

encourage sharing of information and inspiration among presidents of new colleges. As soon as the facilitator assigned by the leading president began to play selfish politics, the other presidents stopped interacting and the network disintegrated (see Project Open Case, Appendix D). By contrast, the National Diffusion Network has elicited substantial voluntary sacrifices from its Developer-Demonstrators and State Facilitators because the USOE officials at the Network's hub treated all the participants as equals during the structuring of Network roles and procedures.

Towards a Definition of Networks for Educational Improvement

Combining the key ingredients of the networks we have examined, we tentatively can define networks for innovation and problem solving. These networks facilitate the sharing of information and psychological support among independent innovators and problem solvers who link together voluntarily as equals seeking assistance not provided by established systems. Taking networks for educational improvement as a whole, their function is to foster the sharing of information and inspiration among independent educators in their local problem-solving efforts and to assist in the development, adaptation or adoption of new programs, products and practices. Specific networks for innovation and problem solving in education have shared purposes which fit the professional roles or specialties of the participants and/or the particular innovations or problems which interest them.

SECTION II

Other Defining Characteristics of the Networks

Networks for innovation and problem solving exhibit many traits in addition to the key ingredients portrayed in Section I. As already mentioned, many of these traits were viewed as vital by one or more of the networking practitioners we interviewed. However, in each case, we found other networks which exhibited a different or conflicting characteristic. It appears that a number of dimensions are involved, with each network falling somewhere along each dimension. Perhaps the dimensions could form a matrix for categorizing networks; but for the time being, we only hypothesize the dimensions for further exploration. Additions, deletions and refinement of the concepts might be necessary. Tentative dimensions include the following:

- Specific and general purposes
- Invention, adaptation and/or replication
- Altruistic and selfish motives
- Inclusive and exclusive admission
- Internal and external financing
- Local, regional and national geographic spread
- Informal and formal structures

Specific and General Purposes

We have already discussed the vital importance to networks of a sense of community and shared purpose, and mentioned the concomitant challenge of defining a sufficiently powerful goal (whether precise or vague) to elicit that sense. While some networks have avoided a formal statement of purpose (e.g., the Northern Westchester Resource Network and Boston West

Biology Teachers), others have achieved a precise definition early in their histories, as in the cases of the NDN and the laser education network. With or without a precise formal purpose, the leading participants in each network could express an overall concern, such as better patient care in the Allied Medical case. Furthermore, active participants in each network could state the objectives of many participants and generally became committed to the entire pool of objectives regardless of internal differences. The stated purpose or overall concern of the active participants elicited the sense of community necessary to accomodate a diversity of objectives, which in turn attracted new participants committed only to specific objectives rather than the network's cause.

Seeking variables to explain differences among network purposes, we encounter contradictions everywhere we turn. The laser education network, for example, has heterogeneous participants and a well-defined purpose, while the Northern Westchester Network has heterogeneous participants and a broad, multi-faceted concern. The homogeneous groups of biology teachers and unified science educators have succeeded with well-defined sharing objectives, while the homogeneous participants in the Superintendents' Network dissolved despite similar sharing objectives. Although one could hypothesize that it is easier to share the "hard" factual content and procedures in scientific and technical fields, participants in the IGE movement and the NDN do a great deal of sharing of "soft" processes. Still another hypothesis would assume that networks created without external financial support (e.g., the science education networks) are more successful than those receiving external funding (e.g., the Superintendents' Network). However, the NDN again begs exception, since large amounts of funding for the NDN brought together participants who rapidly developed a strong sense

of community which has sustained them through an eleven-month gap in their USOE support.

We could continue such chains of contradictory findings. The result most likely would confirm our conjecture that there are no simple guidelines for determining an appropriate purpose and pool of objectives for a network. Through a groping process, each network must formulate the purpose and objectives which elicit the sought-after sense of community from its participants, taking into account their unique local circumstances.

Invention, Adaptation and Replication

One kind of variation among the purposes of networks for innovation and problem solving deserves treatment as a dimension in its own right. While some networks seek to assist their participants primarily in creative local problem solving, others emphasize problem solving by means of adapting existing innovations to fit local needs or of replicating "exemplary" programs, products and practices. Despite this variation, the networks we examined were used by their participants for all three kinds of activities. The networks committed to creative local problem solving exhibit considerable imitation of materials and processes, even if most of the curricula and practices are invented at the site. At the other end of the spectrum, even in networks stressing replication, most local practitioners do develop some of their own materials and processes.

In fact, successful implementation and institutionalization of most educational innovations appears to involve some creative adaptation to local circumstances, as well as some utilization of products and practices developed elsewhere. Processes of invention and replication consequently tend to be mixed in networks -- even if network leaders object to one

practice or the other. Therefore, the title "networks for innovation and problem solving" is used rather than distinguishing "networks for creative local problem solving" from "networks for diffusion of innovations." These two kinds of networks are very unusual and special cases at the extremes of the invention-replication dimension.

Near the invention end of this spectrum are networks like the Northern Westchester Resource Network and the Federation for Unified Science Education. Near the replication end are the National Diffusion Network and the network of the American Kodaly Music Training Institute. The laser education and NTL networks have tended to emphasize adaptation, while the National Center on Educational Media and Materials for the Handicapped (NCEMMH) has emphasized all three approaches during its efforts to help regional, state and local agencies develop collections of print and audio-visual materials for educating handicapped persons. In the cases of the Ohio College Library Center and the Vocational-Technical Education Consortium of States (described in Appendix B), computerized networks have bridged the invention-replication spectrum by promoting invention and replication, but not adaptation. Although each of the three approaches appears to have been effective in some of the networks, the emphasis on replication has encountered special difficulties which deserve further comment.

Several of the networks promoting the replication of tested innovations encourage their participants to sign "letters of agreement" indicating their intended contributions to the network's cause. In the case of participants adopting the NDN and IGE innovations, these agreements usually indicate that the adopter will follow the "exemplary" model as much as possible within the limits of local circumstances. Facilitators in these networks admit, however, that the local circumstances often require a good deal of adaptation.

Furthermore, the networks have found that many of their participants ignore the agreements and make substantial adaptations which are not necessarily required by local circumstances. As reported in the NDN case, there might even be several times as many adaptations being done without the knowledge of Developer-Demonstrators and State Facilitators as there are "adoption" attempts with agreements. Rogers et al. (1976) have tentatively documented this phenomenon for four of the six innovations in college teaching facilitated by the IMPACT Program of the Exxon Education Foundation. Since adaptations usually are untested, the developers of tested "exemplary" innovations are likely to prefer adoptions. Adoption agreements also have the advantage that they indicate a strong linkage within the networks and can be counted by funding agencies concerned with accountability. On the other hand, the adaptations frequently are considered preferable to rejection of the "exemplary" innovations which practitioners refuse to replicate.

The Kodaly movement in music education provides an example of the adoption-adaptation dilemma similar to that experienced by other networks which emphasize replication. After the Hungarian composer Zoltan Kodaly developed a program to teach musical literacy to all kinds of students, the hierachic Hungarian educational system replicated the approach in all of its elementary and secondary schools. An American music educator, Denise Bakin, brought the approach to the United States and began offering teacher training workshops at the Institute which she founded in Wellesley, Massachusetts. The Institute initially emphasized exact replication; this did happen at high cost in a few Connecticut and Massachusetts schools, but did not occur in most American schools due to differences in daily routines and staffing patterns from their Hungarian counterparts. While continuing to offer training and promote replication, the Institute more recently has

begun to function as a facilitating center for the teachers who have attended its workshops and wish to adapt rather than adopt the innovation. These teachers publish a newsletter, use the Institute as their central exchange, and hold national and regional meetings. oreover, they have become active proselytizers for the movement, with the result that Kodaly's approach is now spreading widely, especially in the Middle West.

An analogous situation exists for the Individually Guided Education movement, which includes two overlapping, international networks and many well-organized subnetworks. The two major networks were fostered by the /I/D/E/A/ Change Program for IGE and the IGE program developed by Herbert Klausmeier and his colleagues at the R&D Center for Cognitive Learning at the University of Wisconsin-Madison. During their proselytizing efforts, both programs have used networking strategies to provide external support systems for the schools implementing their comprehensive innovations. Almost immediately, the educators in the networks of one program discovered the networks of the other program, and the state and local networks from the two camps developed overlapping memberships. Before long, the practitioners implementing one or the other IGE approach were not only adapting the approach best suited to meet their special local needs, but also mixing processes and materials from the two approaches. As argued in the case description of the IGE movement (see Appendix D), the networks of synthesizing practitioners (e.g., the New Jersey IGE Network developed by Anthony Conte) probably are the future of the movement, along with the Association for IGE, formed in 1973.

From our diverse studies and interviews, we would suggest that replication-oriented networks might be better off promoting adaptation as well as adoption from the start. A primary emphasis on adaptation might

even be more cost-effective in the long run. An interesting case in point is the Laser/Electro-Optics (LEO) Education network founded by Daniel Hull.

In 1973, Hull was concluding a LEO curriculum development project at Technical Education Research Center-Southwest in Waco, Texas. The project, which was funded by USOE, produced 101 instructional modules for ten courses and tested them in an "exemplary" two-year program for educating LEO technicians at Texas State Technical Institute. However, Hull knew that instructors in most postsecondary institutions, hospitals, firms and government agencies would not be interested in replicating the "exemplary" program because of their special local circumstances and desire to exercise creativity (the "Not Invented Here" factor). When several disparate institutions began establishing LEO programs using various mixes of the trial modules, Hull decided to form a network of people developing LEO programs. Relying on support from a USOE dissemination grant and assisted by the nationwide network of employers and engineers who had helped the development project, Hull began initiating regional meetings of people interested in developing LEO programs. These programs ranged from several weeks to four years in length. Various network participants also developed one-half day to two day short courses for conferences of trade and professional associations, as well as week-long regional workshops.

Program developers were encouraged to exercise free choice among all instructional materials in the field and to develop their own as well. Disproportionately, however, they relied upon various combinations of Hull's modules including one or two course-length sets. Since most of the modules could be adapted not only by altering their mix, but also by

deleting elementary sections or advanced examples within each module, they proved useful with a wide range of students from community college to post-doctoral levels. Before long, several large corporations and government agencies as well as schools were making special orders for sets of modules tailored to their specific training needs. The resulting income to Hull's operation is being used to maintain network facilitating activities now that the USOE grant has ended.

"Altruistic" and "Selfish" Motives

As mentioned in the Section I discussion of psychological support and "family feeling," some networking practitioners stress the role of "altruism" in networks while others argue that "selfish" motives are of central importance. This distinction is partially semantic because the two groups are focusing on different kinds of contributions and benefits. Moreover, some people we questioned call a given behavior "altruistic" while others call it "selfish." Since discussions of motives have been important in some networks, the topic deserves elaboration.

Most participants become involved in networks for one or more of five benefits. These benefits include:

1) Information and resources received from immediate quid pro quo exchanges;

2) Information (and perhaps resources) gained in an unpredetermined manner;

3) Psychological support received in an unpredetermined manner;

4) Positive feelings derived from being part of a special group or "family";

5) The opportunity to help others share and learn.

The first category of benefits is of minor importance because people with such a calculating motivation are usually found only at the periphery of networks for innovation and problem solving. As noted in Section I, it appears that participants with less calculating approaches are more likely to be satisfied by networking activities.

Participants in the second and third categories contribute information and psychological support to other participants without demanding immediate quid pro quo compensation for their time and resources. However, they do expect to get information and psychological support back from the network eventually, and will stop interacting if these benefits are not forthcoming. These participants are exemplified by the following kind of statement: "I didn't know what was in it for me, but I decided to give some time and money to see what might happen for a good cause. I trusted [the facilitator] because his efforts have paid off for me in the past."

As compared to the first category, participants in the second and third groups are "altruistic." On the other hand, these participants frequently consider their underlying motives to be "self-centered" or "selfish" because they seek assistance with their innovative efforts in their individual organizations rather than being concerned for the operation of the network. Participants in the second and third categories also are likely to be suspicious when people in the fourth and fifth categories emphasize "altrustic" motives. Some of the participants from the second and third groups make comments like: "I don't understand why [the facilitator] spends so much time arranging network activities; if I were in his shoes, I would be working on [xyz innovation] in my school."

When most of a network's participants fall in the second and third categories, the network's leaders sometimes attribute "selfish" motivations to all participants, as in the case of Boston West Biology Teachers. (However, direct observation of the BWBT interviewees made us question their stated emphasis on "selfishness.")

Network participants often speak of a widespread "family feeling" in their networks. As indicated in Section I, this "family feeling" is associated with trusting behavior in which participants volunteer valuable or sensitive information. Some participants also contribute to networks explicitly because the networks provide this "family feeling," which is pleasant in-and-of itself. A few participants in this fourth category even place so much emphasis on "family feeling" that they deprecate the objectives of the second and third categories. Although networking practitioners view this emphasis as excessive, they generally concur that "family feeling" deserves inclusion as a major motivating factor. Furthermore, "family feeling" frequently is considered an explanation of "altruistic" behavior.

The use of "family feeling" to explain "altruistic" behavior is consistent with the findings of sociobiologists, documented by Wilson (pages 117-129). As defined by sociobiologists, altruism is "self-destructive behavior performed for the benefit of others" (Wilson, p. 578). This altruistic behavior is so widespread among extended families in certain kinds of insects and animals -- including human beings -- that sociobiologists posit the existence of genes for altruism which spread because they prove important for group survival. At a cost to the resources or well-being of altruistic individuals, other members of the group thrive more than would happen with competition or quid pro quo cooperation.

Of particular relevance to networks for innovation and problem solving is the sociobiology concept of "reciprocal altruism" (Wilson, pages 120 and 551-553). This trait, which has been observed mainly among human beings, can explain the extension of altruism beyond the kinship network to unrelated individuals. Reciprocal altruism involves giving now on the assumption that sooner or later in an unpredetermined way one will receive from the group, or that the people to whom one is giving will in turn give to others some day. Some people consider reciprocal altruism to be "selfishness," while others we have asked view it as "altruism." This difference in perspectives confirms our finding that the conflict over "altruistic" and "selfish" motives is probably more semantic than real.

The motivation of the fifth-category participants, who function primarily or entirely to help other participants share and learn, may be explained by reciprocal altruism. If these participants, who include most of the network facilitators we interviewed, were receiving from others before they became involved in their networks, they now might be taking their turn at "altruistic" giving. A similar explanation can be derived from the developmental model proposed by Erikson (pp. 266-268) in which adults in the "generative stage" are motivated by a desire to give to the next generation through nurturing their children or improving their communities. Perhaps participants in this category have chosen to maintain their networks in addition to, or instead of, giving to families and places of employment. For example, one facilitator suffered a broken marriage for a network and another left a responsible job. On the other hand, some people would argue that this category also derives "selfish" benefits from networks, as evidenced when facilitators talk about how

much they enjoy "helping less experienced teachers," "resolving conflicts," and "convincing people to join the network." In order to resolve differences among conflicting explanations, further research is needed into the underlying motives and psychological needs satisfied by participation in networks for innovation and problem solving.

The CTS hypothesis is that an effective network must offer certain benefits and also have some people who altruistically maintain the network. Reciprocal altruism, at the least, is necessary to begin and perhaps continue the information sharing in a network. If the information could easily have been packaged and sold with existing funds through established channels, the network probably would not have been launched. Typically, however, the value of the information and psychological support shared in a network is not known until after the sharing has been going on for a time.

Network participants who exhibit reciprocal altruism, or who simply enjoy giving, tend to gravitate toward the center of a network, while "selfish" individuals move to the periphery, as already indicated. One of the major tasks of facilitators is to foster this sorting process in a cautious manner which maintains the network's egalitarianism while making certain that the givers also are receivers often enough to sustain their sense of satisfaction. In fact, the excitement for some facilitators comes from the calculating moves and "altruistic" politicking involved in this kind of network matinenance. There can be considerable joy in guiding network interactions so that a diversity of (potentially conflicting) personalities can all make contributions and gain benefits. Similarly, many facilitators take pleasure in catalyzing productive

network get-togethers in which the facilitator does not more than observe the other participants as they learn from each other and develop joint ventures.

The calculated mixture of "altruistic" and "selfish" motives is explicit in the networks we examined which rely upon computers for their information sharing. One of these networks, the Ohio College Library Center (OCLC) network, provides a good example not only of reciprocal altruism, but also of some other dimensions in this Section and the pattern of change portrayed in Section III. Therefore, a detailed description of OCLC is included in Appendix B, which also sketches the use of computers in the Vocational-Technical Education Consortium of States and the National Center on Educational Media and Materials for the Handicapped.

Inclusive and Exclusive Admission

Networks for innovation and problem solving range from ones which are completely open to ones which are highly selective. At the open or inclusive end of the spectrum, the networks are likely to be active proselytizers for their innovation or problem-solving efforts. Middle of the spectrum networks do not actively seek or reject potential participants, but instead rely on word-of-mouth and bulletin announcements of their activities to attract newcomers, who then decide whether or not to join. On the exclusive side of the spectrum, some networks limit newcomers to a specific category, such as those representing a given occupational role. The most exclusive networks function like "old boy" clubs in that their admission process involves sponsorship by one or more members of an inner group.

Although some of the networks we examined have maintained the same admission procedures throughout their histories, others have changed as their fortunes altered. After periods of rapid growth, networks tend to shift to consolidation and internal strengthening. In the process, they can become hierarchical and selective, sometimes even losing their emphasis on egalitarian treatment. New spurts of growth can be initiated by returning to a more proselytizing approach if the network is able.

More specifically, some inclusive networks involve not only highly committed self-selected participants, but also subsidized recruits with varying degrees of commitment. The Wisconsin R&D Center program for IGE provides an instance because the program aims to involve state education departments in order to increase the resources and legitimacy of IGE within the states. To attract these agencies, the Wisconsin program made contracts in 23 states which (in exchange for $5,000 to $30,000 per year) designated "IGE Coordinators" to establish State IGE Networks. The National Diffusion Network also has subsidized the creation of State Facilitators both as means to involve the state establishments and as strategic intermediaries between the Developer-Demonstrators of exemplary programs and the adopters in local schools.

A more widespread attitude among networking practitioners appears to be one of openness to newcommers combined with the expectation that they be committed to the network's cause. For example, the /I/D/E/A/ Change Program for IGE requires both intermediaries and schools to make substantial time and money commitments. The Wisconsin R&D Center also expects commitments on the part of local agencies, as does the National Diffusion Network -- on the assumption that a substantial local input is necessary to achieve full implementation of an innovation.

Another group of networks includes those which are open to anyone who wishes to become involved, but are sufficiently specialized in content that newcomers tend to fit certain patterns by self-selection. Although the laser education network is open to anyone, it attracts only people interested in lasers and other electro-optical systems. The same kind of self-selection holds for the Allied Medical Education network, the Federation for Unified Science Education, the Boston West Biology Teachers, and the Kodaly music network. A variation on these open networks of specialists are the regional and local networks for educational improvement discussed later in this Section.

Moving farther towards the exclusive end of the admissions spectrum, we encounter groups like the Superintendents' Network, the PROJECT OPEN Deans' Network, and the network of the Ford Foundation projects in the Comprehensive School Improvement Program. This kind of network is open to anyone within a designated population (e.g., superintendents or the receivers of Ford grants), but will not accept other participants. The NDN with its ESEA Title III origin began in this category, but has successfully promoted the practices of both funded and unfunded Developer-Demonstrators (DD) and is attempting to broaden the DD selection process to include innovations which were developed with foundation or local support as well as innovations initiated with federal resources.

The remaining networks are exclusive ones consciously limited to specifically-selected participants. In the case of the North Dakota Study Group on Evaluation, the purpose of selection is to confine the network to no more than fifty people concerned with developing ways to satisfy the accountability demands being made upon the open education movement. Vito Perrone, the founder of this national study network,

sought a group small enough that meaningful face-to-face exchanges could take palce among all the participants at annual workshops. Throughout the year, however, Dean Perrone opens the network to anyone interested in the evaluation of open education by using his office at the North Dakota University School of Education as an information exchange. The Youth Project, a nonprofit corporation in Washington, D.C., also has practical reasons for limiting participation in its network of progressive social change groups. During its seven year existence, the Project has learned that a facilitating staff of approximately thirteen people is the largest which its national network can have and still maintain efficient interaction among the staff members. Thirteen staff members, in turn, can effectively serve only 100 to 150 groups of people because the assistance provided includes not only leadership and management training, but also carefully-targeted seed funding.

Internal and External Financing

Networking theorists sometimes make a distinction between "deliberately-stimulated" networking and "spontaneous" or "natural" networking. We have tried to clarify this distinction during our discussions with networking practitioners, but find that they consider all networking deliberate in the sense that they do it in a calculating manner and are aware of being in a network as they do it. "Spontaneous" networking would appear to happen more in personal contact networks than in networks for innovation and problem solving. A more fruitful distinction might be made between networks which are externally-financed and those which are "natural" because they are founded and grow with little or no outside support. Examples of "natural" networks include the networks of

biology teachers, unified science teachers, music teachers, open educators, and the Ohio College Library Center. Near the other end of the spectrum are PROJECT OPEN, the laser education network and the Wisconsin R&D Center and /I/D/E/A/ networks in the IGE movement, which have each relied heavily on one or two external funding sources.

In the middle of the internal-external financing spectrum are several networks. The Educational Improvement Program of the Southern Association of Colleges and Schools started with multi-million dollar contributions from the Danforth and Ford Foundations, but soon began raising a flow of funds from other external sources. The OD Network was started "naturally" but asked NTL for the loan of a part-time facilitator, who in turn helped the Network grow so that it could support a part-time facilitator after it separated from NTL in 1974. Similarly, it is difficult to place the Allied Medical Education network on the financing spectrum because it has a wealthy facilitator, the AMA Department of Allied Health Evaluation, which supports a major portion of the network's expenses. The same is true of the Northern Westchester Resource Network, which relies on the financial resources of Elizabether Meyer Lorentz as well as volunteerism.

No particular pattern of funding appears generally to be more effective than any other. Instead, what seems to matter is the extent to which the network has the key ingredients discussed in Section I, especially an effective facilitator who champions the network's continuation. Most of the individuals named throughout this paper have made major personal sacrifices of time and resources to move their networks past various obstacles. These champions usually are impressive, even charismatic, individuals. In most cases, they are administrators or experienced community organizers with secure institutional bases; a few, however,

are teachers operating almost totally with personal resources. The case of the Federation for Unified Science Education is elaborated in Appendix B because it illustrates, among other points, that two teachers can found a growing international network despite limited resources.

Local, Regional and National Geographical Spread

As FUSE demonstrates, a network can become national and even international despite financial constraints. However, some networking practitioners argue that the geographical spread of an affective network is limited by the need for face-to-face interaction among network participants. Although the quality of this interaction can make a decided difference, some networking practitioners think that face-to-face interaction usually is necessary every month or two. Other practitioners view this rate of interaction as an ideal, but not essential. As a result, the question of geographical spread remains a subject of debate. The experiences of many local, regional and national networks which we examined bear on this question.

The Boston West Biology Teachers, for example, has limited its meeting sites to distances which most members can reach by driving no more than half an hour. Early in its history, the biology teachers network also included participants from suburbs farther away than those west of Boston where the founding members lived and worked. However, as the number of participants grew, subnetworks formed in the northern and southern suburbs which spun off from the main group but kept contact through their facilitators. Through trial and error, all three networks learned that half an hour or 45 minutes of driving time was the most that could be expected of many high school science teachers. The National Center on

Educational Media and Materials for the Handicapped has arrived at a similar conclusion when establishing local resource units in its growing national network. It appears that network facilitators seeking to appeal regularly to teacher in every school in a region must have meeting sites within 25 miles of the schools.

Monthly meetings also are feasible in multi-state regions if networks have travel funds or participants with sufficient commitment to give entire days to the network's activities. The Tri-University Network was designed to appeal to such a group in southern New England and New York. Headed by Saul Cohen from Clark University, Seymour Sarason from Yale University and Mortimer Kreuter from SUNY at Stony Brook, the Tri-University Network limits its radius so that participants can drive to an all-day meeting and back home in one day. When travel expenses were available from a USOE grant to foster Tri-University interaction, monthly meetings were the norm. Without such support, the Tri-University meetings have been less frequent, but the network continues to pursue its purpose of developing a theory of networking and applying it.

Common interests within a multi-state region appear to be important as the Ford Foundation found in its Comprehensive School Improvement Program (CSIP) network. During the early 1960s, the CSIP consisted of autonomous Ford-funded projects scattered from Florida to Alaska, each one attempting to implement a number of "exemplary" programs and practices such as team teaching, programmed instruction, and the use of non-professionals in schools. Beginning in 1966, the Foundation employed Ralph Bohrson and later Paul Nachtigal as "circuitriders" to link the projects together. Annual meetings of the project directors and a few personnel exchanges also were arranged for this purpose. The impetus to

create a network from the projects came in part from Bohrson's successful networking among five of the twenty CSIP projects, collectively called the "Western States Small Schools Project" (WSSSP). During the mid-sixties, five southern CSIP projects formed a second regional subnetwork, with the Educational Improvement Program (EIP) of the Southern Association of Colleges and Schools serving as the network facilitating center. Unlike the EIP and WSSSP networks which were important sources of information and inspiration for their participants, the national CSIP network had a limited impact which made its high travel expenses a questionable investment. The common interests and culture of the Western small schools on the one hand, and the Southern schools on the other, created an environment in which networking was more cost-effective.

The Youth Project also has discovered that regional subnetworks can be more effective than one national network. Through three-person regional staffs located in San Francisco, Washington and Atlanta, the Project has achieved regular face-to-face interaction with the leaders of most of the 100 to 150 groups it serves each year. However, groups in the Midwest receive less attention because they are distant from the regional office sites. The regional offices are linked together by the four-person national staff in Washington, which also maintains relations with the two dozen foundations funding the Project on an open-ended basis.

The approach of breaking national networks into regional subnetworks has been used by other networks as well. The National Center for Educational Media and Materials for the Handicapped (NCEMMH) has thirteen regional centers and the Federation for Unified Science Education has eight. Within the National Diffusion Network, semiformal regional

networks have emerged without a national plan. Furthermore, large national networks like the NDN, NCEMMH and the IGE movement have some well-developed and autonomous statewide networks. All of these national networks, as well as the Kodaly, NTL and OD networks, have experienced similar patterns of national to regional or state development.

Thus, a general pattern can be hypothesized for national networks. Initially, these networks attract highly committed innovators and problem solvers who find the funds and make the time to travel across the nation for meetings. If the networks are promoting "exemplary" programs and practices, the innovations typically "jump" 1,000 miles or more as they are replicated or adapted. Later on, however, a growing network is likely to attract participants who are less willing to find the time and money necessary for nationwide or even regional travel. The national network then must create regional, state and local subnetworks if they are not already in existence. One of the major operational questions in networking is the order and means for fostering these subnetworks. Whatever the approach networking practitioners would prefer, they usually allow initial expansion to be based on subnetwork facilitators who select themselves through commitment and competence.

Informal and Formal Structures

Networks for innovation and problem solving run the gamut from informal and unstructured groups to formal and rather structured organizations. Internally-financed networks like the Federation of Unified Science Educators and the Northern Westchester Resource Network are likely to begin near the informal end of the spectrum and then change or "develop" to a more formal position in the pattern portrayed in Section III.

Externally-financed networks like the Allied Medical and NDN networks usually start at a more formal position because their funding agencies require more plan and structure. However, even these networks have a tendendy to minimiz' structure and formality. This tendency results from the widespread feeling among networking practitioners that formality and structure are dangerous and should be instituted only out of sheer necessity. They fear that formality will inevitably lead to an emphasis on maintaining the network as an institution rather than on achieving the problem-solving and innovation goals of its participants.

Nevertheless, structure and formality do not necessarily impair functioning, as is demonstrated by the Allied Medical and Wisconsin R&D Center networks. In fact, the elaborate structure of the former network probably was required almost from the start as a means to protect smaller network participants from the domination of larger ones, and to provide mechanisms for achieving consensus among conflicting participants. The Allied Medical network even has a "Subcommittee on Terminology" which was created to reduce tensions arising as follows:

> Terms which originally meant something in a particular field have been adopted to mean something different in another field. When members of the different groups get together, misunderstanding, confusion and ill will sometimes result which can be attributed to "the other person's misuse of terms." (Allied Medical Education Directory, p. 35).

Movement along the spectrum from informal to highly structured is not inevitable. Various examples which prove this point are presented in Section III.

SECTION III

A Pattern of Change Within Networks

Sections I and II contain various networking examples which suggest that changes in networks fall into fairly clear patterns. In fact, the histories of many well-established networks like the Federation of Unified Science Educators, the NTL Network and the IGE movement include the same sequence of change beginning with isolated individuals and ending with institutionalized formality. We emphasize, however, that movement through this sequence is not inveitable. At each position in the sequence, networks encounter certain advantages and disadvantages associated with their structures and modes of operation. The limitations of each position can be accepted as givens and the network structure and operations left unchanged. Or, leading network participants or outside funding agencies can take deliberate action to move the network to a different position in the sequence. When networks are created by a funding agency, one or more of the initial positions usually is eliminated.

In this Section, we present the positions in the sequence, emphasizing again that the changes are not inevitable. Our designations for positions in the sequence are arbitrary in that several of them could be sub-divided, or adjacent ones combined. For networking practitioners and funding agencies, we also present some interventions which have been used to overcome the limitations of various positions. Since there can be costs as well as benefits for moving "beyond" each position in the sequence, many people concerned with networking question the ultimate value of the changes. Moreover, they argue that later positions in the pattern

are not necessarily either "better" or "more sophisticated" than earlier ones. It could even be the case that for some objectives, like maintaining informality and flexibility, earlier positions are preferable. The postions in the pattern of changes include the following:

1) Isolated innovators and problem solvers
2) Informal contact networks
3) Deliberate informal networks
4) Building a formal network
5) Institutionalizing the network
6) Dissipation of the network's spirit

Position I — Isolated Innovators and Problem Solvers

Before there can be networks for innovation and problem solving, there must be innovators and problem solvers. There must be opportunities to invent and there must be people trying to solve problems. Without high school biology teachers striving to be better teachers, there would not have been potential participants for a Boston West Biology Teachers. Without the ESEA Title III grants giving local educational agencies the opportunity to develop their own innovations, there would not have been a pool of Developer-Demonstrators for the National Diffusion Network.

Some people concerned with networks talk about the "failure" of change strategies such as national curriculum development projects which were popular during the 1960s. But most network participants whom we at CTS interviewed derived their innovative ideas and their problem-solving interests from the trials and errors they made while participating in the projects of the Fifties and Sixties. Most of these projects

did fail to meet their stated objectives, but they were the raw material from which stem most of the current networks for educational improvement.

The IGE movement provides an excellent case in point. During the 1950s and early 1960s, most of its leaders and many of its active participants were involved in various innovative classroom experiments such as team teaching, nongraded schools, open space schools, and individualized instruction. They estimate that nineteen out of twenty of those experiments failed to achieve permanence, much less imitation by other schools. And yet, the experimenters remained convinced that potentially-superior alternatives to the established system could be created. Headed by Herbert Klausmeier, a group of researchers and educators associated with the Wisconsin R&D Center on Cognitive Learning began developing a synthesis of these innovations and a comprehensive support system including networks for assisting teachers and principals in making the "changeover" to Individually Guided Education. /I/D/E/A/ developed a very similar innovation and support system in response to the same kinds of past "failures." Before long, there were two growing and overlapping networks. Many of the people who began participating in the networks already had tried individualized learning and team teaching without success, but wanted to try it again because they still believed in individualization. The IGE movement gave them the opportunity.

By implication, the major limitation on potential network participants during this initial phase was lack of resources, freedom for experimentation, and opportunities for teacher learning. Although outstanding champions of innovations can operate in environments without support (as documented in Parker, 1971), the task of improving education

is made easier in an environment which provides time and resources specifically for applied research, development, demonstration, and teacher training. During this phase, teachers and developers also need freedom from concerns about evaluation and dissemination (see Brickell, 1964).

Position 2 — Informal Contact Networks

Aided by resources for experimentation and teacher development, innovators and problem solvers frequently seek contact with other people interested in the same kinds of innovations and problem-solving efforts. In some cases, the innovators and problem solvers obtain all the information and psychological support they need from informal professional contacts. This is most likely to be the case with high-level administrators and with leaders in various professions because they have budgets and experience to support extensive interaction with professional contacts. When we discussed networking with these individuals, they typically would respond to the concept by saying "everyone I know does that; what's new?" These individuals have no reservations about making multiple long distance phone calls to seek out the answer to a question. As part of their jobs, many of these individuals also are expected to arrange face-to-face get togethers with colleagues at the opposite end of the nation.

These administrators and leaders often rely on "old boy" networks in their fields of endeavor. Since they were already satisfying their need for information through informal contact groups, they sometimes expressed little interest in the more formal networks of the sort CTS is studying. One established leader worked with a formal network initially, but later withdrew his support when he realized that the network was assisting other participants to become as knowledgeable and powerful as he was in dealing with state and Federal authorities.

On the other hand, some influential administrators and leaders of professions have freely shared their knowledge gained from "old boy" networks with the less-established participants in formal networks as a means to building a powerful movement. Several leaders in the IGE movement exemplify this altruistic attitude.

Informal contact networks might work well for many administrators, but what about the teachers "under" them? In order to answer this question tentatively, we at CTS interviewed four innovative elementary and junior high teachers (see Appendix E). We also relied upon discussions with participants in the Boston West Biology Teachers. Although this study was small, our findings were consistent with those of House (1974:69) and Lorti (1977:17-22).

The teachers reported that they and other innovative teachers they knew often began their efforts by solving the problems in their own classrooms. During the first year or two at a new grade level or setting, they developed their own curriculum and routines, relying in part on their own creativity and in part on ideas they had gained through courses in local colleges and meetings of professional associations. Like other innovators (see Rogers, 1962) they were more "cosmopolitan" than many of their colleagues because they made a point of taking courses and attending meetings outside their schools. Although they received minimal encouragement from other teachers in the schools, they did receive psychological support from parents' networks which emerged to assist their innovative efforts.

When the teachers had mastered their innovative practices after two to five years, they tended to develop morale problems. They spoke about boredom and getting in a rut. According to the teachers we interviewed, many innovative teachers "turn off" and become robots at

this point, using the same routines in isolation year after year. They expressed the fear that the same would happen to them. As an alternative, the teachers began reaching out to other people with whom they wished to share their expertise and from whom they sought psychological support. They suddenly wanted to do things like teaching a seminar at a local college or leading an inservice seminar for their school.

For example, Eva Paddock was pleased to help set up an inservice seminar in her open classroom approaches to teaching arithmetic when asked by the mathematics supervisor of the Cambridge School Department. Although the seminar which resulted was a success for the other teachers, Paddock derived too little benefit to wish to repeat the seminar a second semester. The next year she instead initiated a weekly sharing session among several dissatisfied teachers in her school and recruited a volunteer psychologist to join them. At each session, they conveyed their successes of the week before and then focused on problem areas. Again, after a year, Paddock decided that this "therapy group" approach was insufficient as a means to maintain her teaching energy. She then joined a federally-funded Follow Through project where she finally has found the information sharing and psychological support she needs at a reasonable personal cost. In fact, Paddock now has a surplus of energy, which she has used to initiate a system-wide inservice seminar for teachers wishing to share information and inspiration related to their individual problem-solving efforts.

The other teachers report similar challenges. They can and do form contact networks which share information and psychological support. From these networks, they have derived the satisfaction of watching other teachers imitate their innovative programs and practices. However,

the personal costs of creating and maintaining the contacts have proved to be high. Unlike the upper-level administrators, the teachers must pay for each long-distance phone call. Furthermore, they seldom can stop teaching for a day, much less a week, to attend meetings elsewhere in the nation. Many teachers do not have a secluded desk with a phone, as CTS found when we were trying to arrange interviews with participants in the Boston West Biology Teachers. Extensive sharing of information and psychological support generally must be done after school or during weekends, at a considerable cost to their private lives. Only when teachers become involved with a special project, a teachers' center, or a network which has been developed deliberately to meet their needs can many of them continue to innovate and solve problems in a satisfying manner. Based upon extensive studies and personal experience, John Goodlad has arrived at a similar conclusion which he documents in his 1975 book.

Given Goodlad's experience with the League of Cooperating Schools, as well as the CTS network research, we suggest some possible interventions by funding agencies at this position in the pattern of network change. Inservice credit and/or released time sometimes are sufficient encouragement for teachers to create and maintain a local network for innovation and problem solving. Reimbursement for phone and travel expenses also can tip the cost-benefit scale in favor of networking. In addition, some kind of formal recognition can be helpful in providing a sense of legitimacy. It is important that this support be given in particular to potential facilitators who are inclined to build a network and have the appropriate kinds of interpersonal skills. These individuals are best identified by finding the fledgling, informal networks they have already created, and then helping to expand the networks.

We hypothesize that this kind of support is most likely to be cost-effective for teachers and principals. As already indicated, higher level administrators have internal ways to support networking. If they really want to share information and psychological support in their efforts to innovate or solve a given problem, administrators often can build their own networks. They also have relatively easy access to federal and state resources which can be used for networking, such as the expense accounts of advisory committees associated with research and demonstration projects or of task forces focused on problems of interest to established systems. By carefully selecting the members of such committees, we have seen administrators achieve more than adequate face-to-face interaction among the active participants in an informal network for innovation and problem solving.

Position 3 — Deliberate Informal Network

It is a small step from an informal contact network to a deliberate informal network for innovation and problem solving. Some of the examples given in Position 2 are relevant here as well. However, it appears that someone in an informal contact network must make a decision to begin facilitating regular interaction if the contact network is to become a network for innovation and problem solving.

The people who initiate a new network oftentimes have already met each other at seminars, advisory committee meetings, and association conferences. Although these people know that they have similar concerns, no one initially makes a serious attempt to interact on a regular basis. The five teachers who founded Boston West Biology Teachers provide a relevant example. For two years, they had been running into each other at teacher training institutes sponsored by the National Science Foundation

and at regional or national conventions. At the end of each chance meeting, they would say that they should get together more often but would not do it. Then, when three of them met by chance at a local college's greenhouse, one asked the other two to meet at his high school. He also invited the two other teachers whom they had met at earlier institute and association sessions. During the subsequent meeting, the five teachers decided to meet monthly, and to invite additional teachers to join them. Thus, a network for innovation and problem solving was initiated.

Similar stories are sketched regarding the Federation for Unified Science Education in Appendix A and the Ohio College Library Center in Appendix B. The NTL network, the Tri-University Network, and the Northern Westchester Resource Network also began in this manner. Furthermore, many subnetworks within larger networks, like the IGE movement and the National Diffusion Network, fit this model.

In some cases, the new networks remain small and un-named. They make little or no effort to recruit new participants, and develop no more structure than periodic meetings. Our interviews indicate that many leaders of professions and high-level administrators maintain this kind of unstructured informal network. These "old boys" simply make a point of getting together at least once a year, even at some personal inconvenience.

Another group of informal networks develops a little more elaborate structure including a name. Oftentimes, they prefer the word "group" as in the case of the North Dakota Study Group on Evaluation. Also they are likely to have an occasional elaborate activity, such as the annual workshops of the North Dakota Group. In some cases they seem to be able to persist unchanged for years, generally as fairly exclusive networks.

The "Junto" founded by Benjamin Franklin (1961: 70-82) is an outstanding example of such an exclusive network or "club for mutual improvement." Often meeting weekly, the Junto lasted for nearly forty years, during which time it undertook various problem-solving efforts including development of the first American lending library, which inspired imitations throughout the nation.

Unlike the Junto, the North Dakota Study Group, and possibly the Tri-University Network, most of the networks we examined began to develop various networking mechanisms early in their histories. These were designed to expand and/or strengthen their networks. With or without external financial support, these networks soon exhibited many of the structural traits and routines characteristic of Position 4.

Position 4 — Building a Formal Network

If the participants decide to expand and elaborate their network for innovation and problem solving, they generally develop a number of networking mechanisms. The order of development appears to depend upon the personal interests of leading participants as well as strongly expressed group needs. None of the mechanisms is essential as long as a network does not take the institutionalization step to Position 5. Possible networking mechanisms include the following:

- an agreed-upon name
- a formal statement of purpose
- a directory of participants
- a catalog of participants' programs
- releases for publicizing the network
- designated facilitators or coordinators
- an exchange or facilitating center
- annual donations from participants
- a newsletter or bulletin

- a magazine or journal
- case studies of problem-solving efforts
- handbooks for innovation or problem solving
- curriculum materials
- surveys of participants' needs and resources
- orientation and training workshops
- meetings for planning and trouble-shooting
- an annual or semi-annual conference
- various cooperative projects

Networks which enter this phase typically require a year or two of network building before they are able to turn their primary attention to sharing information and psychological support. Because no networking mechanism is crucial and the preferences of participants in different networks vary, CTS found no general pattern for development of these mechanisms. With the exception of the Tri-University Network, all of the externally-funded networks started developing many of these mechanisms soon after they were funded. However, for ideological or political reasons, some of the well-funded networks would ignore a device which others emphasized. For instance, the IGE movement and the National Diffusion Network each lack one agreed-upon and well-functioning exchange, while the Allied Medical network and the Youth Project began with this mechanism. Low-budget networks sometimes have more difficulty developing a wide range of mechanisms, but usually will find ways to compensate including a heavy emphasis on the use of volunteers. For example, participants in the Boston West Biology Teachers, the OD Network, and even the National Diffusion Network in its early days, volunteered to refine their address lists, memorandums or meeting notes so that these could be used by other network participants as directories, case studies or newsletters. Although the resulting products were not so polished as

some of the networking devices in the better-funded or more experienced networks, they served the purpose of facilitating interaction and information exchange. In fact, some of the networks have consciously avoided polishing their networking mechanisms for fear of shifting the network's emphasis from sharing to institution building.

If the number of participants and the amount of interaction in a network continues to increase, the central facilitators experience increasing pressure to develop more formal and polished mechanisms. The case of the Federation for Unified Science Education, elaborated in Appendix A, illustrates this point well. Telephone, postage and xeroxing costs are likely to become a growing burden, as is the sheer volume of materials accumulating at a facilitating exchange. First one and then two, three and more full-time facilitators are needed, and in turn a growing flow of funds becomes essential. Facilitating units based in established organizations then experience pressures to become permanent programs with line-item budgets rather than project funding. This happened, for instance, in the cases of the National Diffusion Network's unit within the USOE, and the Educational Improvement Program within the Southern Association of Colleges and Schools. Similarly, some participants in the internally-financed networks with independent facilitators begin talking about the need to incorporate and obtain tax exempt status. On the other hand, some networking practitioners argue against institutionalization because it almost inevitably requires at least a temporary displacement of sharing objectives by survival concerns. Some networks such as the Boston West Biology Teachers consciously stop changing somewhere before this point and remain formal, but non-institutionalized networks. Other networks move on to Position 5.

Position 5 — Institutionalizing the Network

As part of becoming a corporation or a permanent program in another organization, a network for innovation and problem solving usually develops formal governance procedures. If it does not already have an agreed-upon name and purpose, these also are formalized. Otherwise, the network can continue to function with the mechanisms created in Position 4, but tends to elaborate and refine these mechanisms as a natural response to expanding numbers of participants. Informal guidelines tend to become formal policies, and verbal agreements based upon trust tend to be replaced by written documents. Furthermore, the size (and needs) of the facilitating staff tend to grow.

It is precisely these requirements and tendencies of institutionized networks which many participants fear. As one of the leaders in the biology teachers network said, if an organization must have a governing board, it usually ends up creating nominating committees and sooner or later has power politics as well. If informal guidelines become formal policies, they become more difficult to alter in response to the changing situations of network participants. Written agreements require more time and precision even if they reduce the chances of misunderstanding. In a network with a strong family feeling and trust, misunderstandings often can be ignored or surmounted, making written agreements unnecessary. Some networking practitioners also argue that the concern for formal agreements and policies tends to kill the family feeling and trust. Likewise, a growing staff can lead to bureaucratic elaboration of procedures, to say nothing of its increasing need for money.

Some institutionalized networks make policy decisions designed to resist these tendencies. The Youth Project, for instance, decided to limit

its staff size and the number of participants in its network. Furthermore, the Project's Board of Trustees is limited to individuals who are under thirty years of age as a means to avoid domination by an "old boy" sub-network. On the other hand, the Federation for Unified Science Education asked its two founders to be permanent Board members in hopes that they would continue their altruistic facilitating for years to come and would inspire a generation of Board members to do the same. In order to avoid becoming a fragmented association of competing specialists, the OD Network leadership has refused to create subdivisions for its different subgroups, while at the same time encouraging the development of inter-disciplinary regional networks. The OD Network also has turned down proposals to have formal presentations of papers, for fear that these would reduce informal sharing of working papers and ideas.

Even if these kinds of policies combat the bureaucratic tendencies of institutionalized networks for a time, a long-run challenge remains--facilitator succession. As indicated in Section II, all of the effective networks for innovation and problem solving have had impressive facilitators at their cores. What happens when these individuals move on to other jobs or grow old? Anticipating such eventualities, the facilitators of Position 4 and Position 5 networks attempt to prepare experienced successors. The Youth Project and the OD Network already have weathered changes of leadership with success, while the Allied Medical network recently avoided a major change when the AMA asked Ralph Kuhli to continue past the normal AMA retirement age. However, networking practitioners fear that sooner or later staff bureaucrats will take over and maintenance of the facilitating center will become the staff goal, rather than egalitarian sharing of information and psychological support among network participants seeking to innovate and solve problems in the given field.

Position 6 — Dissipation of the Network's Spirit

When maintenance or expansion of the facilitating center becomes the primary goal of a network, the trust and altruistic spirit of the network is likely to dissipate. Some participants reflect this development by making comments like "why should I contribute my time and effort when the staff are paid to do the same activities?" As a by-product of the example set by acquisitive staff members, the participants also tend to become increasingly calculating in their interactions with each other. If the network has gained enough popularity to acquire funds for supporting a permanent staff, it also is likely to have begun attracting participants who have little or no commitment to the shared purpose held by the original network "family." In the process, the network for innovation and problem solving becomes an established bureaucratic institution no longer offering its innovators and problem solvers the kind of information sharing and psychological support which was its original function. At some point, many of them "turn off," becoming passive members of the now established institution or leaving it entirely. Two consequences are evident--either the emergence of an established system with its bureaucracy and inflexibility, or the death of the institution as the participants stop supporting the staff.

Conclusion: The Emergence of New Networks

Regardless of whether the final position in the pattern of network change results in an established system or in disintegration, the need is likely to emerge for a new means to share information and psychological support among innovators and problem solvers in the given field. This need sometimes can be met immediately by subnetworks of the dying network which separate from it when it shows signs of dissipation or of becoming an established system. A relevant example is the OD Network separation from the National Training Laboratories during 1974 when the NTL network with its forty-person staff was disintegrating. On the other hand, many of the participants in NTL and other former networks are left without any support group because they have not created or joined subnetworks which are immediate viable alternatives. In these cases, we return to Positions 1 and 2 with isolated innovators and problem solvers creating professional contact networks. A new cycle begins in the continuing quest of individuals for alternative ways to improve their schools, their communities and their lives.

APPENDIX A

The Federation for Unified Science Education

Unified science education is an outgrowth of the progressive education approach conceived by Harold Alberty at the Laboratory School of the Ohio State University College of Education. During the 1930s and 1940s, Alberty developed a "core" curriculum routine in which elementary and secondary pupils selected all of the topics to be studied and the teachers then devised or located the necessary means to teach them. After Sputnik in 1957, however, the faculty of the Lab School decided that it should place more emphasis on math and science by designating special times every day for these subjects. Led by Irwin Slesnick, the faculty discussed possible interdisciplinary approaches to teaching science, and in September of 1959 hired Victor Showalter, a high school chemistry teacher, to help implement a pilot program.

Slesnick and Showalter began developing multi-disciplinary instructional units around concepts such as "motion" and "equilibrium," and phenomena such as "the sun" and "perception." Since each of the units integrated or "fused" elements from two or more of the separated sciences, Slesnick and Showalter called their approach "unified science education." After developing the innovation for three years, they were joined by Barbara Thomson, who came to the Lab School in 1962 from a sixth grade teaching position. A year later, the three completed the first rigorous comparison of the unified science approach with other innovative science curricula, such as PSSC physics and BSCS biology. Unified Science held up well in the comparisons.

Encouraged by the evaluation results, Showalter and Thomson began publicizing the innovation. (Slesnick took a job elsewhere in 1963.)

Some people read about the unified science approach in The Science Teacher, while some others heard Slesnick, Showalter and/or Thomson make presentations at conventions of the National Science Teachers Association (NSTA) and other societies. Another group discovered Unified Science at the Lab School, which they visited because they were followers of Alberty or students at the Ohio State College of Education. The School also was included in tours mapped by the National Science Foundation (NSF) for educators from abroad. Since the unified science approach emphasized development of units by the individual classroom teacher, its materials were not amenable to easy packaging or replication. However, they inspired adaptations by some of the visitors who had been seeking an interdisciplinary approach as an alternative to the established science curriculum with its fragemented specialties.

Although Showalter and Thomson did not proselytize actively, groups of teachers in eight schools from Florida to Wisconsin had developed similar programs by 1966. The teachers kept contact with Showalter and Thomson and suggested that the two initiate a national meeting. A three-day conference was planned for September of 1966, to which seven teachers paid their own way.

During this intensive "formative conference," the teachers decided to start an on-going, self-help group. They debated whether to begin recruiting other members, but decided to expand only as other people came to them in response to presentations at professional association conferences and journal publications. Emphasizing their desire to remain unstructured, the teachers rejected the idea of becoming an association. After the teachers returned to their homes, two of them independently suggested that the group be called the "Federation for Unified Science

Education" because they liked its acronym FUSE and they felt that "federation" implied less structure than "association" or "society."

From the start, the teachers treated Showalter and Thomson as the facilitators for the new network. The two have always operated as a team because they learned early that teaming offered them psychological support and greater effectiveness when they needed to "sell" the network. Anticipating the 1968 closing of the Lab School, Showalter took a job with the Educational Research Council of America located in Cleveland, but continued to share facilitating responsibilities with Thomson. The latter kept the growing FUSE files in her office at Ohio State, where she eventually became a tenured faculty member. The facilitators attended regional and national conferences every month or two at their own expense in order to give unified science presentations or to meet with network participants. In addition, FUSE held an annual meeting, began a bulletin, and facilitated numerous school visits.

Since 1968, FUSE has held its national conference at the site of a different unified science program each year. The FUSE network grew to include approximately 500 participants by 1971, most of whom were teachers in middle schools, high schools and colleges. By then, fifty participants had year-long unified science programs and about 100 were making optional donations of $2.00 each year. Some highly committed teachers also contributed $10-$20 during face-to-face interactions with Showalter or Thomson, while Ohio State University and the Educational Research Council provided some secretarial, Xeroxing and phone assistance. FUSE now has 6,000 participants on its mailing list, including 600 from abroad, and receives voluntary annual dues of $5 from about 1,000 people.

From 1968 onwards, some of the FUSE participants argued that the

network should incorporate and become tax exempt in order to receive certain benefits such as low mailing rates for the bulletin. They also wished to establish by-laws which would institutionalize their "altruistic" policies before the growing popularity of the movement attracted "selfish" individuals. After Thomson explored the benefits of incorporation in other states, FUSE became an Ohio corporation in 1971 and obtained tax exempt status a year later. Following the corporate charter, dues-paying members began electing five of the seven members on the Board of Trustees. The remaining positions were filled by Showalter and Thomson, who became permanent Trustees thanks to the demands of other incorporating members. As before incorporation, the FUSE leaders continued to hold annual "open sessions" at NSTA and the annual FUSE conference where any member or non-member could make inputs to FUSE policy decisions.

In 1971, Showalter and Thomson approached NSF for assistance because they needed some relief from the burden of facilitating a 500-member network while working full-time in minimally-related jobs. NSF officials had been aware of the FUSE phenomenon and wanted to keep closer track of it since it appeared to be a growing movement in science education. As a result, NSF has given FUSE four project grants, beginning in the Summer of 1972, to help create and maintain the Center for Unified Science Education (CUSE). In order to avoid possible conflicts of interest, Showalter resigned his Cleveland job and headed FUSE as a full-time volunteer for six months before the first CUSE grant was awarded. With Showalter as Director and Thomson as Coordinator, they expanded the exchange operation which they had already begun using their personal files. CUSE also began subsidizing the development of audio-visual instructional materials by various network participants in response to

widespread requests from the network. The Center now has over seventy of these modules, but continues to publicize both its own and other instructional units donated by network participants and commercial publishers.

The Center has not supported the development of complete texts because FUSE encourages network participants to "engineer" their own curricula using the unified science philosophy and guidelines. Since teachers who visited the Center to investigate its files have come away with many ideas for their own classes, other network participants began requesting regional duplication of the CUSE files. As a result, FUSE plans to create regional facilitating centers within driving distance of any science teacher; eight of these centers have already been established. The FUSE trustees also have approved the creation of "Information Sites" at the locations of unified science programs which lack one or two of the elements required to become regional centers, but deserve formal recognition in their efforts to help other developers of unified science programs. At the same time, FUSE is serving a growing international clientele including UNESCO interns and FUSE-Australia.

Although FUSE has relied upon NSF-funded projects for part of its support, both Showalter and Thomson and the regional center coordinators continue to view high school and college teaching as their primary sources of income. When active FUSE participants become school administrators, they have tended to move (or be pushed) to the periphery of the network. Thus, the network despite its international stature still is dominated by people committed to teaching. As long as this pattern continues, FUSE is likely to avoid a shift to a stress on institution building and instead remain committed to share information and psychological support among teachers developing unified science programs.

APPENDIX B

Computerized Networks for Innovation and Problem Solving

Three of the networks we examined are computerized for their information sharing function. These networks are the Ohio College Library Center, the Vocational-Technical Education Consortium of States, and the National Center on Educational Media and Materials for the Handicapped. Some networking practitioners argue that computerized networks of any sort should not be considered in the same category as networks for innovation and problem solving. Rather than taking a stand on this issue, we present these examples of computerized networks as an appendix in hopes that it will stimulate further inquiry.

Before giving the examples, the negative attitude towards computerized networks deserves further comment. Underlying this attitude appears to be at least two concerns: 1) the low cost-effectiveness of some computer uses in education, and 2) the fear that computer technology will destroy the "warmth" and "family feeling" of effective networks. From interviews, CTS has concluded that the people who participate in innovative computerized networks can exhibit all of the network traits discussed in Section I. "Family feeling" concerning other network participants is no exception. Computer networks also have a literature describing many traits, dimensions and terms which are the same as, or analogous to, those presented in this paper (see the articles in Greenberger, 1974). Moreover, some networks find that computerization is the only cost-effective means to share information. This happened in the case of the Ohio College Library Center (OCLC).

The origins of OCLC go back to 1951 when several presidents from schools in the Ohio College Association (OCA) formed an ad hoc committee

to develop an effective way to share their library resources. After six years of exploring several alternatives including a manually-operated union card catalog, they disbanded without finding a cost-effective approach. In 1960, the president and the head librarian of Ohio State University reconstituted the informal network of OCA members concerned with library sharing. The group again explored a manual approach to operating a union catalog. However, the group was unable to reach agreement on a specific proposal, and then took the advice of Frederick Kilgour and another national expert to instead create the nation's first computerized shared catalog. Kilgour was selected to direct the innovative effort, which began in 1967.

Librarians had talked about sharing for years but had done little due to practical problems of cost and institutional autonomy. Using a computer, how could OCLC not only overcome these obstacles, but also achieve two objectives: to increase the availability of library resources for participants, and to reduce the rate of increase in certain library costs? The answer has proved to be a network in which each contribution by a participant can benefit many other participants. Although someone must pay the immediate costs of making the contribution, all participants can benefit before long in several ways.

A major OCLC benefit is the elimination of duplicate cataloging activities. The cataloging process, which involves classification of a document's intellectual content, is one of the most expensive library procedures because it requires a great deal of professional time. Moreover, when the content of a book is cataloged, libraries must produce catalog cards in a process including typing, proofing and card reproduction. Librarians generally can catalog about one and a quarter books per hour.

By contrast, the OCLC shared cataloging system makes it unnecessary for more than one participating library to catalog an item. For example, 133 participating libraries have acquired catalog cards for Solzhenitsyn's Gulag Archipelago, yet only one library has cataloged it. The other 132 simply "asked" the computer if it had the item, and then signaled the computer to have OCLC produce and mail duplicate catalog cards.

The OCLC computer also can "tell" a user which libraries have a book available through inter-library loan. The user sometimes decides to buy the book after seeing that no library in his or her region has it, or that it is so popular as to belong in every library. In either case, the librarian can obtain OCLC catalog cards for the book once its purchase is indicated to the computer system. Thanks to computerization, OCLC can offer the cards and other services at relatively low prices and still finance its overhead and development operations. However, the entire OCLC network relies upon the "altruistic" inputs of the libraries which make the first entries of new items. These libraries pay the labor costs of cataloging the new entries and adding them to the data base or "online catalog."

The OCLC design was elaborated by Kilgour and several staff members during 1967-71. At the time, he and the staff were supported by 54 Ohio college libraries which made formula-based financial donations depending on their size, but which governed the nonprofit OCLC corporation as equals. Federal and foundation support were sought as an alternative, but none was forthcoming. Using its own resources with a little help from Xerox Corporation, the OCLC network finally began online computer operations during 1971. Once the network proved successful for the Ohio libraries, out-of-state libraries asked to join.

The network has since grown to a $15 million annual operation encompassing 88 Ohio libraries and over 850 academic, public, state and specialized libraries in 44 other states. Many of these out-of-state libraries use the OCLC system through regional networks such as the group for the southeastern U.S., called Solinet. The regional networks, which are governed and financed independently of OCLC, have assumed some of the administrative and training functions which OCLC performs for other participants. Currently, OCLC is exploring the possibilities of extending corporate membership to out-of-state libraries. (Under OCLC's present charter, only Ohio libraries may elect members of the coporation, who in turn elect a nine-person Board of Trustees.)

As a result of its success, OCLC is called a "giant" in the library world and increasingly is treated as part of the "established" system. While its founders were dedicated to innovating new kinds of computerized library services, most of OCLC's participants have been concerned with quality control regarding entries in the already-established online catalog. An informal OCLC "user group" has been meeting at the semi-annual conventions of the American Library Association to discuss quality control problems, and OCLC maintains a "Peer Council on Quality Control." (These groups focus on both poor quality entries and duplicate entries which happen when librarians cannot find, or dislike, original entries.) The OCLC network has even become sufficiently established to cause some feelings in the library world that there should be alternatives to the system. Consequently, three fledgling computerized networks have begun, in California, Illinois and Washington.

Despite OCLC's "giant" size, the majority of its participants altruistically continue to input new entries to the online catalog.

Older participants still have the "family feeling" which characterized the original Ohio group, and new participants soon develop the same. The result is a strong network norm that participants should input for everyone's benefit as well as continuing improvement of the nation's library services. Of the 16,000 books and monographs cataloged per day in 1975-76, the Library of Congress alone accounted for 2,000 entries, despite the fact that it is OCLC's major competitor in selling printed catalog cards. (OCLC sold 39.6 million cards during its 1975-76 fiscal year.) Many participants make certain that all of their new acquisitions are included in the computer bank, and some are inputting old acquisitions as well. A few participants are systematically adding all their materials at high short-run costs because they envision a long-run return.

An excellent case in point is the National Center on Educational Media and Materials for the Handicapped. NCEMMH is the Ohio State-based hub of a national network including thirteen semi-independent regional centers, over 100 totally independent state and intermediate educational agencies, and over 800 local resource units for educators of handicapped persons. Through a pioneering arrangement with OCLC, the National Center inputs not only the information on a catalog card, but also an abstract of each book or other instructional material cataloged. Several State Education Agencies are joining OCLC so that their special education divisions can more easily tap the NCEMMH information bank, and one local school system has asked to join. Looking ahead, the National Center sees OCLC as a public vehicle by which any institution can have access to information on materials for educating the handicapped. From Kilgour's viewpoint, NCEMMH is sharing the development costs of including abstracts in OCLC. As this practice is perfected and per-unit costs decline, it

could become increasingly relevant to the information sharing operations of other networks for educational improvement.

A third computerized network, the Vocational-Technical Education Consortium of States (V-TECS), has encountered a noteworthy difficulty in maintaining its substantial contributions. The idea for V-TECS was conceived by Kenneth Eaddy and Roy Giehls of the Division of Vocational-Technical and Adult Education in the Florida Department of Education. At the cost of approximately $200,000 during 1969-72, they developed "catalogs" of educational and performance objectives for four occupational areas. Since they wanted to formulate catalogs for a total of 216 areas, they soon realized that Florida could not finance the achievement of their goal. They also knew that many other states and the federal government were funding similar efforts. Therefore, it seemed logical to obtain agreement among the states to use the same format and share their catalogs rather than duplicating efforts. Computerization of the catalogs had the added benefit of reducing the costs of amending the catalogs in response to feedback from teachers, students, workers and employers.

The Florida Department of Education donated $30,000 to the Southern Association of Colleges and Schools (SACS) for a feasibility study by Bob Childers and Ben Hirst, Jr., who later became V-TECS Executive Director, SACS then called a national conference which was attended by representatives from five northern states and eleven southern ones, seven of which launched the cooperative venture in July of 1973. In exchange for adding at least two catalogs each year at a cost of $44,000 or more, the seven states were given access to the catalogs produced by the other states. Each state was represented on a governing board, which resolved differences among states if two or more wished to develop catalogs for the same

occupation or to change the standardized format of the catalogs.

Independant adaptations of the format were not permitted for fear that they would result in significant variations in the quality and usefulness of V-TECS :tarial. As mantioned in the Section II discussion of Invention, Adaptation and Replication, V-TECS and OCLC encourage the creation of new inputs and the replication of existing data, but dislike adaptation, unlike some other networks CTS examined. NCEMMH condones adaptation in the content of instructional materials being collected in the regional and local resource units of its network, but not in making catalog and abstract entries into the OCLC data bank. Standardization of format is essantial to most computarized networks.

With some support from the U.S. Office of Education, V-TECS developed an effective operation. Two additional sourthern states and seven northern ones joined in the process, while the U.S. Air Force and Navy Training Commands have become Associate Members and four northern states are negotiating entry. One of the original southern states has dropped out because it wanted to alter the operational procedures and standardized format, but probably will rejoin because the other members continue to accept the V-TECS practices. However, several non-member states are demanding access to the V-TECS catalog bank without agreeing to contribute catalogs. Arguing that the bank is public domain, these non-participants threaten the reciprocal altruism which has fostered the network's growth and effectiveness. In response, V-TECS is designing a "Subscriber" membership for states which would pay for the use of catalogs rather than contributing them in exchange for access to other catalogs. It is hoped that Subscribers eventually will be influenced by the family spirit of V-TECS and become contributing participants.

APPENDIX C

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APPENDIX D

List of Network Case Histories

(Main people providing information listed in parentheses)

Allied Medical Education Network by Priscilla H. Claman & L. Allen Parker

(Ralph C. Kuhli, Director, AMA Dept. of Allied Health Evaluation
Mary-j Waterstraat, Executive Director, Am. Medical Record Assoc.)

*Nuclear Medicine Technician Education Network

Boston West Biology Teachers by Priscilla H. Claman and L. Allen Parker

(Helen Foynes, Watertown High School
Lawrence Nilson, Weston High School
Sue Plati, Wellesley High School
Harold Wiper, Newton North High School)

Ford Comprehensive School Improvement Program Network by L. Allen Parker

(Ralph G. Bohrson, Program Officer, The Ford Foundation
Paul Nachtigal, Project Specialist, The Ford Foundation)

*The SACS Education Improvement Program

(Donald C. Agnew, former Director
John E. Codwell, former Deputy Director
Edsel T. Godbey, Director)

Individually Guided Education Movement and Its Networks by L. Allen Parker

(Leslie C. Bernal, Executive Secretary of the Assoc. for IGE
George Glasrud, Wisconsin IGE Coordinator
Donald Griffin, Michigan IGE Coordinator
C. William Phillips, Ohio IGE Coordinator
Nancy Sandberg, Director of M.Ed. on Individualizing Education
Notre Dame College, New Hampshire
Bernie Schmitt, Principal, Haen Elementary School, Wisconsin)

**The /I/D/E/A/ Change Program for IGE

(John I. Goodlad, Director of /I/D/E/A/ Research Division
Gilbert L. Johnson, Associate, /I/D/E/A/ Innovative Programs Div.
Lyn Simmons, Associate, /I/D/E/A/ Innovative Programs Division
Charles L. Willis, Program Officer, /I/D/E/A/)

*The New Jersey IGE Network

(Anthony E. Conte, New Jersey IGE Coordinator)

**Wisconsin R&D Center Program for IGE

(Herbert J. Klausmeier, Director, IGE Teacher Education Project
Walter Krupa, Associate, Wisconsin R&D Center for Cognitive Learning
L. Joseph Lins, Project Administrator, IGE Teacher Education Project
James E. Walter, former Director of Implementation, R&D Center)

*Major subnetwork described at length in one section of the case.
**Major subnetwork described in paragraphs scattered throughout the case.

Laser/Electro-Optics Education Network by L. Allen Parker

(Daniel M. Hull, General Manager, Technical Educ Research Center - SW
James R. Johnson, Research Associate, TERC - SW)

The National Diffusion Network by L. Allen Parker

(David P. Crandall, Massachusetts Facilitator
Mary L. Smith, Project Adventure Developer-Demonstrator
Lee E. Wickline, Director, Division of Educational Replication
Bureau of School Systems, U.S. Office of Education)

*The Minnesota Facilitator Project at The EXCHANGE

(Diane D. Lassman, Director
Ellen B. Meier, Associate)

Northern Westchester Resource Network by L. Allen Parker

(Elizabeth Meyer Lorentz, Co-Lay Coordinator
Richard A. Sussman, Coordinator)

**The Superintendents' Network and PROJECT OPEN by L. Allen Parker

(Malcolm E. Shaw, President, Educational Systems & Designs, Inc.)

Multi-University Network by L. Allen Parker

(Saul B. Cohen, Director, Grad School of Geography, Clark University
N. Dickon Reppucci, Associate, Institution for Social and Policy Studies, Yale University
Seymour B. Sarason, Associate, Institution for Social and Policy Studies, Yale University)

APPENDIX E

List of Networking Practitioners Interviewed

*American Kodaly Music Training Institute (Priscilla H. Claman interviewer)

Denise Bakin, Director
Ann Silvernow, Assistant Director
Three Kodaly trained teachers in New England

*Federation for Unified Science Education (L. Allen Parker is interviewer)

Victor Showalter, Director
Barbara S. Thomson, Coordinator

IMPACT Program, Exxon Education Foundation (Parker)

Caryn Korshin, Program Manager

Institute for Responsive Education, Boston University (Parker)

Don Davies, Director
George Thomas, Consultant

M.I.T. Center for Advanced Engineering Study (Claman and Parker)

Myron Tribus, Director

*National Center on Educational Media and Materials for the Handicapped

Carl F. Oldsen, Assistant Director (Parker)

National Self-Help Resource Center (Claman)

Susan A. Davis, Executive Director

*National Training Laboratories network (Parker)

Matthew B. Miles, leading member

National Urban League, Department for Economic Development (Parker)

Malon T. Puryear, Director

Networks for computer-based research and education (Parker & David Robinson)

Jean Graef, Systems Analyst, Ohio College Library Center
Paul Johnson, M.I.T. complex decision making experiments

*New England Appropriate Technology Network

Mark Sarkardy (David Robinson is interviewer)
David Schlesinger (Parker)
Mark Tomlin (Parker and Robinson)

NEXUS Service, American Association for Higher Education (Parker)

Jane Lichtman, Director

*One of the 28 networks used in the comparative analysis

*North Dakota Study Group on Evaluation (Parker)

Vito Perrone, coordinator

*Ohio College Library Center (Parker)

Frederick G. Kilgour, Executive Director
Phillip Schieb , Editor
Jean L. Graef, Systems Analyst

*The OD Network (Parker and Robinson)

Warner Burke, former Executive Secretary

*Outdoor experiential education networks (Parker and Kirk Thomas)

Gilbert Leaf, former Outward Bound staff member
Mary L. Smith, Associate Director, Project Adventure

Resources for Alternative America (Parker)

Richard Gardner, editor

Southern Association of Colleges and Schools (Parker)

Felix C. Robb, Director
Bob E. Childers, Executive Secretary, Commission on Occupational Educational Institutions

*Teachers' Centers Exchange network (Parker)

Kathleen Devaney, Director
Lorraine Thorn, Associate

Teachers professional contact networks

Eva Paddock, Cambridge School Department (Parker and Claman)
Heidi Eberhardt, Weston Public Schools (Claman)
Daniel Kunitz, Newton Public Schools (Claman)
Joan Marszalek, Charles River School (Parker)

*Vocational-Technical Education Consortium of States (Parker)

Ben A. Hirst, Jr., Executive Director

*Youth Project (Parker)

Charles Savitt, Associate

CTS Networks Development Program

L. Allen Parker, Executive Director of CTS
Priscilla H. Claman, Networks Exchange Coordinator
Paul Ferrini, Associate
Paul Johnson, Associate
David Robinson, Associate
Kirk R. Thomas, Associate